

Patent Claims:

1. An electronic control system for a vehicle,  
c h a r a c t e r i z e d by a driver request module  
(29) for determining characteristic quantities with  
respect to the driver's request from data at least  
representative of pedal travels, movements of the foot  
changing between the pedals and the brake pressure of the  
brake system, and a risk calculator for determining the  
risk potentials from predefined and current vehicle data  
and additional data, such as ambience data and driver  
data, and optionally data of persons inside and outside  
the vehicle, and similar data, and the risk calculator  
performs at least an assessment of the condition of danger  
of the vehicle and the occupants in the vehicle and, in  
case of need, of the ambience still and, depending on the  
assessment and on further criteria or weightings, outputs  
controlling interventions graded according to the risk  
potential for controlling actuators to an arbitration  
unit, and said arbitration unit performs an assessment  
with the data determined in the driver request module with  
regard to the driver's request depending on an action  
influencing the driving dynamics of the vehicle brought  
about by the controlling interventions and, depending on  
the result of the assessment, releases the graded  
controlling interventions to a limited extent, releases or  
blocks them.
2. The electronic control system as claimed in claim 1,  
c h a r a c t e r i z e d in that the repositioning  
movement of the foot between the accelerator pedal and the  
brake pedal is determined from accelerator pedal travel

information and the stop light information as input quantities.

3. The electronic control system as claimed in claim 2, characterized in that the time of repositioning the foot from one pedal to another is determined from the input quantities.
4. The electronic control system as claimed in any one of claims 1 to 3, characterized in that the driver request module (29) supplies the characteristic quantities determined to the subsequent arbitration unit.
5. The electronic control system as claimed in claim 4, characterized in that the driver request module supplies further characteristic quantities with respect to a steering request and/or acceleration request to the subsequent arbitration unit (28).
6. The electronic control system as claimed in any one of claims 1 to 5, characterized in that the risk calculator calculates risk potentials from data representing at least the vehicle longitudinal speed, the vehicle longitudinal acceleration, the vehicle lateral acceleration, the distances from relevant objects in the local area and/or remote area and/or their derivatives and state data about driving dynamics controllers such as ABS, HBA, ESP, and like systems, said risk potentials, at least in dependence on determined longitudinal-dynamics and/or lateral-dynamics risk characteristic quantities, producing

controller outputs graded in their effect and dependent on the determined risk potential for the brakes, for the reversible occupant protection means and for the adjusting devices that change the relative position between occupant protection means and vehicle occupants.

7. The electronic control system as claimed in any one of claims 1 to 6,  
c h a r a c t e r i z e d in that the controlling interventions for the actuators, in particular for the brakes, are carried out in conformity with the situation.
8. The electronic control system as claimed in any one of claims 1 to 7,  
c h a r a c t e r i z e d in that the risk calculator (10) calculates risk potentials from data representing at least the vehicle longitudinal speed, the vehicle longitudinal acceleration, the vehicle lateral acceleration, the distances from relevant objects in the local area and/or remote area and/or their derivatives and state data about driving dynamics controllers such as ABS, HBA, ESP, and like systems, said risk potentials, at least in dependence on determined longitudinal-dynamics and/or lateral-dynamics risk characteristic quantities, producing controller outputs for closing vehicle openings.
9. The electronic control system as claimed in any one of claims 1 to 8,  
c h a r a c t e r i z e d in that depending on the risk potential determined, the risk calculator (10) further generates optical and/or haptic warnings and/or directions to warn and/or guide the driver to a reaction that is

adapted to the current vehicle situation and passes on these warnings and/or directions directly to the actuators (18, 16) for realization.

10. The electronic control system as claimed in any one of claims 1 to 9,  
c h a r a c t e r i z e d in that the warnings are given by means of a vibrating pedal and/or seat and/or by a display.
11. The electronic control system as claimed in any one of claims 1 to 10,  
c h a r a c t e r i z e d in that the directions are given by means of a modified control force on at least a pedal or the steering wheel.
12. The electronic control system as claimed in any one of claims 1 to 11,  
c h a r a c t e r i z e d in that the risk calculator calculates risk potentials from data representing at least the vehicle longitudinal speed, the vehicle longitudinal acceleration, the vehicle lateral acceleration, the distances from relevant objects in the local area and/or remote area and/or their derivatives and state data about driving dynamics controllers such as ABS, HBA, ESP, and like systems, said risk potentials, at least in dependence on determined longitudinal-dynamics and/or lateral-dynamics risk characteristic quantities, producing information for the non-reversible occupant protection means and for the control systems of the non-reversible occupant protection means.

13. The electronic control system as claimed in any one of claims 1 to 12,  
c h a r a c t e r i z e d in that the arbitration unit includes a state machine which arbitrates the characteristic quantities provided by the driver request module (29) such as the brake pedal travel, the brake pedal speed and/or the accelerator pedal travel, the accelerator pedal speed, and the time of repositioning the foot between the accelerator pedal and the brake pedal and/or the condition (on/off) of the stop light and/or measured and calculated brake pressures of the brake system and/or their derivatives and/or the acceleration of the vehicle and/or the risk potentials determined by the risk calculator and/or their derivatives with respect to the controlling interventions determined by the risk calculator.
14. The electronic control system as claimed in any one of claims 1 to 13,  
c h a r a c t e r i z e d in that the correlation of the characteristic quantities of the driver request module with the controlling interventions of the risk calculator is assessed, and the controlling interventions sent to the actuators are released to a limited extent, released or blocked depending on the result of the assessment.
15. The electronic control system as claimed in any one of claims 1 to 14,  
c h a r a c t e r i z e d in that the value of the controlling interventions is modified depending on the result of the assessment.

16. The electronic control system as claimed in any one of claims 1 to 15,  
c h a r a c t e r i z e d in that the risk calculator determines different risk potentials and combines them for producing the controlling interventions.
17. The electronic control system as claimed in any one of claims 1 to 16,  
c h a r a c t e r i z e d in that a risk potential is calculator by way of a fuzzy system and/or in a driving-dynamics model.
18. The electronic control system as claimed in any one of claims 1 to 17,  
c h a r a c t e r i z e d in that the risk calculator determines general risk potentials and special risk potentials, with the general risk potentials being actuator-independent and the special risk potentials being actuator-dependent.
19. The electronic control system as claimed claims 1, 11 to 17,  
c h a r a c t e r i z e d in that the arbitration unit includes a state machine which arbitrates the characteristic quantities provided by the driver request module (29) such as the brake pedal travel, the brake pedal speed and/or the accelerator pedal travel, the accelerator pedal speed, and the time of repositioning the foot between the accelerator pedal and the brake pedal and/or the condition (on/off) of the stop light and/or measured and calculated brake pressures of the brake system and/or their derivatives and/or the acceleration of

the vehicle and/or the risk potentials determined by the risk calculator and/or their derivatives with respect to the braking interventions determined by the risk calculator.

20. The electronic control system as claimed in claim 19, characterized in that a braking intervention is determined depending on the characteristic quantities accelerator pedal travel, brake pedal travel and/or brake pressures and/or acceleration and/or their derivatives and/or a stop light information of the driver request module representative of the driver's request, and levels for maximum decelerations are derived according to threshold values of these characteristic quantities and the risk potentials.
21. The electronic control system as claimed in claim 20, characterized in that the degree of the braking request of the driver is defined by a characteristic factor that is determined depending on the weighting of the following conditions:
  - a) ratio of the brake pedal travel to the maximum of the brake pedal travel,
  - b) ratio of brake pedal speed to the maximum of the brake pedal speed;
  - c) factor assessing the time of repositioning the foot from the accelerator pedal to the brake pedal.
22. The electronic control system as claimed in claim 20, characterized in that the degree of the braking request of the driver is defined by a

characteristic factor that is determined dependent on the weighting of the following conditions:

- a) ratio of a brake pressure requested by the driver to the average maximum of an emergency brake pressure;
- b) ratio of the time gradient of the brake pressure requested by the driver to the average time gradient of a maximum of an emergency brake pressure;
- c) factor assessing the time of repositioning the foot from the accelerator pedal to the brake pedal.

23. The electronic control system as claimed in claim 20 or 21,  
c h a r a c t e r i z e d in that an emergency brake situation is derived from the time variation of the brake pressure and the stop light information and the time variation of the risk potential.
24. The electronic control system as claimed in claim 23,  
c h a r a c t e r i z e d in that when the emergency brake situation is detected, the deceleration calculated by the risk calculator is conducted entirely as a nominal value to the brake actuators.
25. An arbitration unit for an electronic control system of a vehicle,  
c h a r a c t e r i z e d in that it is connected to a risk calculator (10) and a driver request module and arbitrates characteristic quantities supplied by the driver request module (29) with respect to controlling interventions determined by the risk calculator.



26. The arbitration unit as claimed in claim 25,  
c h a r a c t e r i z e d in that it includes a state machine.
27. A risk calculator for an electronic control system of a vehicle,  
c h a r a c t e r i z e d by a model for calculating actuator-specific and actuator-unspecific risk potentials from quantities which are calculated or measured by devices of the vehicle.
28. The risk calculator as claimed in claim 27,  
c h a r a c t e r i z e d in that the devices of the vehicle are remote and/or local area sensors, driving-dynamics sensors, travel sensors, pressure sensors, vehicle models and/or hydraulic models.
29. Electronic control system for a vehicle,  
c h a r a c t e r i z e d by a signal conditioning device (21), a risk calculator (10), a driver request module (29), and an arbitration unit (28).
30. Method for determining at least one driver-independent intervention into a vehicle system,  
c h a r a c t e r i z e d in that in a driver request module including characteristic quantities with respect to the driver's request, a driver's request is determined from data being at least representative of pedal travels, movements of the foot changing between the pedals, and the brake pressure of the brake system, and risk potentials

are determined in a risk calculator from predefined and current vehicle data and additional data, such as ambience data and driver data, and optionally data of persons inside and outside the vehicle, and similar data, and the risk calculator performs at least an assessment of the condition of danger of the vehicle and the occupants in the vehicle and, in case of need, of the ambience still and, depending on the assessment and on further criteria or weightings, outputs controlling interventions graded according to the risk potential to an arbitration unit for the purpose of controlling actuators, and said arbitration unit performs an assessment with the data determined in the driver request module with regard to the driver's request depending on an action influencing the driving dynamics of the vehicle brought about by the controlling interventions, and releases the graded controlling interventions to a limited extent, releases or blocks them depending on the result of the assessment.

31. Method for determining risk potentials for a vehicle control system,  
c h a r a c t e r i z e d by a model-based determination of actuator-independent and actuator-dependent risk potentials from input and output quantities of the vehicle.